

Coupling Between Doppler Radar Signatures and Tornado Damage Tracks

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On April 27, 2011, the southeastern United States was raked with several episodes of severe weather. Numerous tornadoes caused extensive damage, and tragically, the deaths of over 300 people. In Alabama alone, there were 61 confirmed tornadoes, 4 of them produced EF5 damage, and several were on the ground an hour or more with continuous damage tracks exceeding 80km. The use of Doppler radars covering the region provided reflectivity and velocity signatures that allowed forecasters to monitor the severe storms from beginning to end issuing hundreds of severe weather warnings throughout the day. Meteorologists from the NWS performed extensive surveys to assess the intensity, duration, and ground track of tornadoes reported during the event. Survey activities included site visits to the affected locations, analysis of radar and satellite data, aerial surveys, and interviews with eyewitnesses. Satellite data from NASA's MODIS and ASTER instruments played a helpful role in determining the location of tornado damage paths and in the assessment. High resolution multispectral and temporal composites helped forecasters corroborate their damage assessments, determine starting and ending points for tornado touchdowns, and helped to provide forecasters with a better big-picture view of the damage region. The imagery also helped to separate damage from the April 27th tornadoes from severe weather that occurred earlier that month. In a post analysis of the outbreak, tornado damage path signatures observed in the NASA satellite data have been correlated to "debris ball" signatures in the NWS Doppler radars and a special ARMOR dual-polarization radar operated by the University of Alabama Huntsville during the event. The Doppler radar data indicates a circular enhanced reflectivity signal and rotational couplet in the radial velocity likely associated with the tornado that is spatially correlated with the damage tracks in the observed satellite data. An algorithm to detect and isolate the "debris ball" from precipitation signatures in the dual polarization radar data has been developed and verified using the NASA damage track data.